Piezoelectric materials overview

Noheda, B.

Published in:
Current Opinion in Solid State and Materials Science

DOI:
10.1016/S1359-0286(02)00022-0

Publication date:
2002

ELSEVIER

Current Opinion in Solid State and Materials Science 6 (2002) 9

Current Opinion in **Solid State & Materials Science**

Editorial

Piezoelectric materials overview

B. Noheda

Condensed Matter Physics, Vrije Universiteit, 1081 HV Amsterdam, The Netherlands

Material scientists have maintained a keen interest in piezoelectric materials over the years, partially encouraged by a rapidly developing electromechanical industry. On the other hand Solid State scientists have, for some time, regarded piezoelectricity as an old-fashioned topic more suitable for undergraduate textbooks. Recently, however, this perception seems to have changed considerably with a large increase in the number of scientific papers devoted to fundamental aspects of piezoelectricity, which in turn has resulted in a better and more fruitful communication from which both communities have benefited.

This section reviews the major breakthroughs that have been responsible for the current revival of piezoelectricity, namely, the growth and characterization of high-strain single crystals of lead oxide solid solutions, the discovery of low symmetry phases associated with the high piezoelectricity, and the development of first principles calculations for dealing with real piezoelectric systems. The latest advances in the area are presented in four independent articles that address different aspects and include the most relevant work related to applications, such as single crystal performance and crystal growth, as well as to more fundamental issues, like symmetry-property relationships and first-principles calculations in piezoelectric materials.

In the first article Seung-Eek Eagle Park and Wesley Hackenberger examine the high performance of piezoelectric single crystals and single crystal composites as actuators and transducers for actual applications (ultrasound imaging, accelerometers, sonars, etc.), as well as the possibilities of future developments in this area. In the second paper Laurent Bellaiche analyzes the current approaches to the first-principles determination of the piezoelectric tensors at zero and finite temperature, which are not only successful in explaining the observed behavior, but also allow for the design of materials with predetermined and tunable properties.

The third article reviews the recent work on the structural properties of the lead oxide solid solutions, and the discovery of low-symmetry phases, which are believed to be responsible for the high electromechanical response of these systems. In the fourth review Zuo-Guang Ye examines different crystal growth techniques for relaxor-ferroelectric lead oxide solid solutions and their suitability for the synthesis of more homogeneous crystals, together with recent studies on the domain structures associated with the low-symmetry phases and high piezoelectricity of these crystals.

E-mail address: noheda@nat.uv.nl (B. Noheda).

1359-0286/02/$ – see front matter
PII: S1359-0286(02)00022-0